

SIXPENCE

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SOLVING THE RECTIFIER REGULATION PROBLEM.

By G.F. COLE. VK2DI

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Many amateurs just go blindly along in their choice of Power supply filter components. However a little time spent in this direction will result in longer rectifier life, fewer blown filter condensers, less heating of the power transformer, and last but not least, almost perfect no load to full load regulation. The discussion to follow will be limited to the common single phase, full wave circuit shown in Fig. 1.

The regulation of a rectifier and filter combination is governed by the following three components.

1. The I X or commutation reactance drop.
2. The I R or d.c. resistance drop.
3. The charging effect of the filter condenser.

The first component can be kept to a very low value by proper transformer design, details of same being outside the scope of this article....

The second can be reduced to a small value by using rectifier tubes, chokes, and power transformer having low d.c. resistance, hence low voltage drop. Mercury vapour rectifiers are almost essential as the internal voltage drop is almost independant of load current variations, and remains at approx. 15 volts during the useful life of the tube. For that reason it is surmised that mercury vapour tubes are to be used...

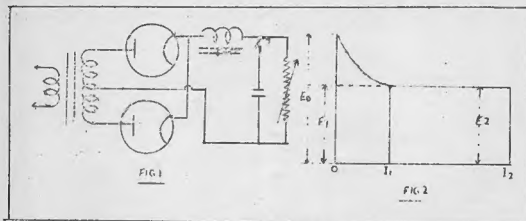
The third, the charging effect of the filter condenser is more difficult. If the rectifier had no filter that would be the end of the matter. The rectifier would deliver the average value of the rectified voltage wave less regulation components 1 and 2. As component 1 is usually small, it can be neglected for most practical purposes.

Then $E_{d.c.}$ equals $(0.9 E_{rms.} \text{ less } 15 \text{ volts rectifier drop})$ where $E_{rms.}$ is the RMS volts per rectifier plate. However, with the filter connected there is the ever present tendency

with small load currents for the condenser to charge up to the peak value of the rectified wave. With no load current, this value is equal to - 1.57 times E d.c. - where E d.c. is the rectifier output voltage.

As the current increases the filter output voltage falls rapidly until the current I_1 is reached. See Fig. 2. For loads greater than I_1 the regulation depends only on the D.c. resistance of the choke and transformer voltage drop. Therefore for good regulation the minimum load current should at least be equal to I_1 . The filter condenser and choke bear an important relation to each other and to the value of the current I_1 .

The main purpose of the filter is to remove the fundamental a.c. component which has a value of 66.7% of the average rectified d.c. output. Since this component is purely a.c. it encounters only a.c. impedances in its circuit. If we designate the choke impedance X_L and the condenser X_C both at the ripple frequency, the impedance to the ripple is X_L minus X_C . From this it can be seen that the greater the inductive reactance (the larger the choke inductance) the smaller the "condenser charging effect" and the better the



regulation. The condenser reactance also affects the regulation but to a less degree than that of the choke. In a well designed filter X_L is high compared to X_C . Also it can be seen that the predominant element in determining the value of the minimum load resistance R_L for good regulation is the choke.

$$\text{Equating } R_L \text{ equals } \frac{X_L - X_C}{0.667} \text{ ohms.}$$

From the above it follows that the lower the choke inductance the lower R_L and the higher the minimum current for the desired regulation. Good engineering practice is to have a bleeder current equal to 10 - 15 % of the full load current.

REPRODUCING RECORDS WITH LARGE RADIUS NEEDLES.

It has been generally accepted that a needle with a tip of as small radius as possible is desirable for optimum reproduction from lateral cut gramophone records. This is based on the theory that the modulations are of equal lateral amplitude throughout the depth of the record groove, and it was therefore considered that a needle fitting tight to the bottom would penetrate the groove farthest and so give the greater high frequency response.

It has recently been claimed that some unexpected benefits can be obtained from the use of a needle point of larger radius which makes contact only with the upper side walls of the record grooves.

Graphical comparisons were made between three sizes of needle tip....0.0023 in; 0.00275 in; and 0.004 in....the bottom radius of the groove being 0.0022 in; the width 0.006 in; and the included angle 88 degrees. It was apparent that the greater area of contact was given by the smaller radius needle tip due to its close fitting in the bottom of the groove.

An enlarged plan view of part of a modulated record groove, with a 0.004 in needle inserted, was also presented. The modulations represented a sine wave of 7000 c/s near the inside of a 78 rpm standard record with a peak-to-peak amplitude of 0.0004 in. It was obvious that the full amplitude could not be traced by a radius tip of such dimensions, and it would seem that an increased amplitude could be obtained by decreasing the needle radius, thus allowing it to drop into the groove.

In a curve showing the effect of tip radii, varying from 0.002 in to 0.006 in., the electrical output for a constant frequency of 5000 c/s with 0.002 in peak-to-peak amplitude, other factors being unchanged, the maximum output was reached with a tip radius around 0.004 in.

This increase of high frequency output results from the fact that HF modulations are not impressed in equal amplitudes throughout the depth of the groove, and are less at the bottom which can be attributed primarily to certain stages in record manufacture. During processing the grooves are distorted by the chromium plating, which deposits a heavier coating on the raised surface (corresponding to the groove bottom), and in pressing, the raised portions become worn and distorted by the squeezing of the "biscuit" of record material across the surface.

Two records pressed from the same stamper were reproduced by the same turntable under identical conditions, except for the needle tip radius. An improved signal-to-noise ratio was obtained with the 0.004 in needle.

Measurements made of the signal-to-noise ratio in the modulated groove show that a large radius needle tip still retains a superior signal-to-noise ratio at 500 play backs. Other curves reveal that there is an appreciable reduction in surface noise at 7000 c/s with the wider needle, and that the tracking at 94 c/s is more accurate.

If the results are confirmed by further work being carried out, it would seem that the explanation for tolerable quality record reproduction with fibre and other non-metallic needles, lies in the fact that the tips must of necessity broaden rapidly.

(Taken from an article in 'Wireless World')

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(Continued from page 2)

The selection of the value of the input choke is important in keeping the rectifier peak current within the tube rating. The inductance is given by the equation -

$$L \text{ min. equals } \frac{R.L.}{1000} \quad H_y.$$

The above formula gives the minimum inductance, the optimum value being 2 times L min.

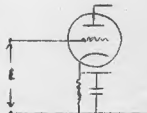
However for "Ham" purposes it is more economical to use the minimum inductance and to use a larger bleeder current, than to purchase a larger inductance. The alternative is a swinging choke, the design of which is difficult, or a "tuned choke filter" of which I will not attempt to write at present.

In two section filters the second section has nothing to do with the regulation, except for the DC resistance of the choke which causes some voltage drop.

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A CORRECTION

In the January issue of the article Vacuum Tube Voltmeters the diagram in Fig 7 was partly incorrect. The correct input circuit is shown here.



.. FOR SALE ..

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U.S. ARMY SETS.

Few facts have been published about the sets used by the U. S. Army, but here are some of the details about some of the pack sets--or "walkie-talkies" as they are called---at present in use.

One of the most interesting of the transceivers used is type 511. This set is now being extensively used by the infantry for communications between company and battalion. The circuit of this set, which is fixed tuned on six frequencies is not available, but some of the salient features in design may be given.

"Miniature" technique is employed in the design of this nine tube set, which is housed in a metal case measuring approximately 6 x 6 x 8 inches, mounted on a heavy 3 foot 6 inch spike which is used for inserting in the ground. Access to valves etc. is gained by sliding the base plate down the spike. This reveals a second plate which, when withdrawn, comes away with the screening cans of all the valves. Incidentally, rubber cushioning is provided in each valve screen.

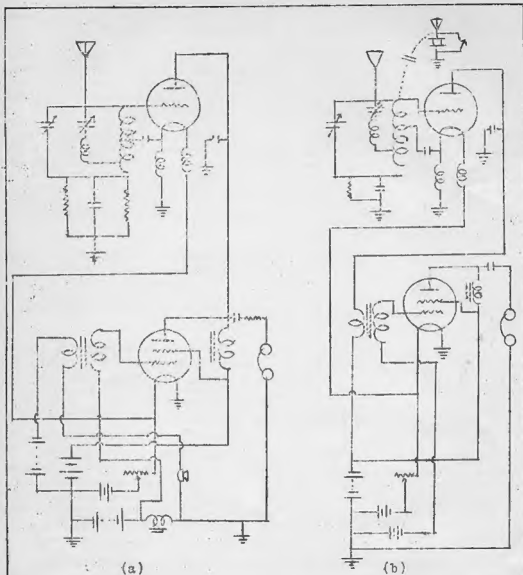
The joints of the case are rubber faced to render them waterproof under most conditions; it can be passed through water without damage, but would be damaged if left submerged. The set is switched on by extending the 6 ft. telescopic aerial which is fitted to the top of the case. The send-receive switch is fitted on the case near the base of the antenna.

A case measuring about 10 x 9 x 2 inches is carried on the operators chest and contains the combined HT/LT battery, spare coil and combined microphone-loudspeaker. The power supply is connected to the set through a multiple cable and a nine point plug. Total weight of the set is 16 lbs. and it is stated that it has been used with considerable success in North Africa and at Guadalcanal.

Another set which is in use has been styled the "handie-talkie." This transceiver used for communication between platoon and company is about 14 in. long. It is used like the hand-piece of a modern desk telephone. Miniature technique is also employed in the construction of this 7 tube set, which weighs approximately 5 lb. Very few details are available however, regarding the circuit.

The original "walkie-talkie" pack set is a two valve combined transmitter receiver of considerably large size and weight. The complete outfit, including batteries carried in a can as haversack weighs approximately 27 lbs. When used as a transmitter one valve functions as the oscillator in a modified type of crystal controlled hartley circuit; the anode being

(Continued on page 14)



Circuits taken from U.S. Army instructional manual showing basic circuits of the original "walkie-talkie" when functioning (a) as a transmitter and (b) as a receiver.

TECHNICAL LIBRARY

U.S.F. TECHNIQUES...Brainerd, Kochler, Reich and Woodruff
Massachusetts Inst-Technology..1942
570 pages.....38/3.

This book was produced by the above panel of authors to provide a text book of radio theory for senior engineering students in US Universities. The whole work was completed in a remarkably short time, being printed by the offset process (facsimile of the original typescript) to save time involved in setting up in the usual type form.

Although written chiefly from the UHF angle it is almost entirely applicable to lower frequency work and should be of immense value to radio engineers working in almost any field of the science.

The arrangement is interesting, commencing as it does with an analysis of linear circuits, which is later developed to include circuits having the conventional coil and condenser combination.

Following this introduction there is found a thorough treatment of Tubes, over Supplies, Amplifiers, Trigger Circuits and C.R.Tubes.

Having laid a solid foundation the authors then pass to Modulation, Demodulation, Receivers, Transmitters, UHF Generators Transmission, Radiation and Wave Guides.

The book is terminated with a Bibliography which is by far the most complete we have ever seen in any technical book.

The whole of the text is amply illustrated with diagrams and the authors have contrived to keep mathematical and literal subjects in their proper relation to each other so that a general idea of any chapter may be had by skimming the maths, and returning to them for fuller information later.

We can say without any exaggeration that this is the finest radio book yet to hand, and although shipments so far have been small it is worth waiting for.

HIGH FREQUENCY ELECTRONIC TUBES...A.F.Harvey (London)..1943
235 pages ..30/-

This is a fine specialist volume and can be recommended to anybody wanting sound basic information on the types of tubes used and their behavior at High and more particularly Ultra-High Frequencies.

Beginning with two introductory chapters, dealing with General Properties (with reference to Rectification, Amplification, Negative and Positive Feedback) and Influence of Frequency on Operation, it passes on to a discussion of the main types of High Frequency Generators. In this section are included Cill-Morrell, Backhausen-Kurz, Magnetron and Klystron generators. The Magnetron is given special attention, occupying about half the entire volume.

The book is rounded off with a discussion of wave-guides and horn radiators, followed by a very complete bibliography. Both the illustrations and the text are well arranged.

Oh boy! did you see that polite little crack over the head with a piece of rubber hose filled with lead shot, ye ole Ed., put at the end of this column last issue???? And poor old ZYC innocent as a new born babe. It is all you correspondents sending in reports late, or not at all that causes the "trouble" ... and that lets me out... and, though the veracity of the statement may or may not be open to serious question, what's the use of a column if you can't "pass the buck" and then declare correspondence on this subject closed Hi!

There is nothing like having ones judgment vindicated for all and sundry to see. Some time ago "I" made a Captain out of a Sergeant, and loud were the heehaws that greeted me at the VK2 Divisional Meeting. Well, laddies read the following from the "Mentioned in Despatches" list in a recent paper ...

"Sgt. A. E. Peppercorn of Bexley, Sydney, served as signals N.C.O. of the wireless telegraphy detachment station at an important base in New Guinea, and was responsible for the installation and maintenance of wireless apparatus. Despite many severe raids, the station functioned continuously."

Now, I ask you, was a mere Captaincy enough!!! But there is one "doubtful" point - those "raids" - were they the mosquito type he mentioned or a new kind of raid of a different variety - hi! Fb, Om anyway, congratulations from "all the Hems."

VK3CB rang up tonight - he is over here in VK2 protem. He sent me a packet of gramophone needles for Sid Clarke up in Milne Bay but alas like other parcels these days they went astray - tough luck Sid, Om. Of course Ed. I said to him - Oh no - you can't come out tonight - the Mag. Committee won't let me - hi!

A letter from P/o Cec Light to Harold Peterson 2HP seems to indicate that Cec certainly has had a good time since he arrived in England. By now Cec should be flying a Lancaster round about the place, possibly sending a few QSL to the D's.

On the back of VK2FYs subscription form he mentions that of the old gang around his area. ZGM is playing around with transmitters for the RAAF in Darwin. ZAPC an ex Grafton Ham is also in the RAAF somewhere while ZCJ & ZNY still stay around the old home town, the former busy with BCL sats and the latter spends all his spare time with the Sigs section of the local VDC.

Bruce O'Brion VK2OH is another of the VK2 gang who disappeared into the blue soon after the war started. Harold Peterson had a note from him which tells us he is in Group 944 RAAF up Townsville way. Bruce had very little to say about his doings so he must be on the Hush Hush sections. Hi. Anyway, Bruce its nice to know just where you are.

The 30P, 2ALF, and their VK6 companion seem to have once more gone to sea, to help the Yanks up North one presumes, so here's wishing them another safe and quick return. How's the admiral well, om?

Lieut. Joe Ackerman seems to have started off on a new tack, where the "beard" is quite the rage. Hi! 2ALG writes that he is now in the 3 Aust Water Tpt Gp. (Small Craft) Sig. Section. And that is quite a change from Alice Springs and Katherine. Hi. Joe says he did a course of Seamanship at Flinders, along with 3DA who is going to 2 Group, while there saw 2FF, 2AFJ and 3XP.

Captain V. L. Cole VK2 AG3 is now stationed in Melbourne where he is engaged on the design of Radio Equipment.

Several letters from 3GY to 3NX reveal that he got up to LAG without Jim noticing it. Clem (3GY) has been in the Darwin area for about ten months now and is looking forward, hopefully, to some leave which should come his way in another five months or so. He has had a few trips to the coast and endeavoured to acquire some sun tan but had to be content with a crop of nice blisters.

News comes of L/Cpl Jim Watson 3NQ. Jim is with a Signal Tng Btn at Bonegilla and reports meeting Geoff Pryor 2AMP recently. Although he believes there are several other hams in the vicinity he has not come in contact with them yet. The home shack at Darlington just missed the disastrous fires in the Western District recently, a change in the wind from north west to westerly swinging the fire away when it was within half a mile of the house. Missing Darlington the fire swept to Derrinallum where 76 houses were destroyed. Jim writes that his younger brother Alan has now returned up in England. Receiving his Commission in Australia, Alan passed through the States on his way and while there he looked up W2CC who has kept in touch with 3NQ for ten years or so both by radio and letter. Alan writes he was given a great welcome by W2CC..(from what I have heard W2CC has the real Ham "spirit"--2YC).

LAC W.Gaze who hopes to take out an amateur ticket after the war and who is the prospective ham to be introduced by Vic Smith 3UR writes an interesting letter. He has been on the move quite a bit during the past few months but hopes he is settled for the time being. Most of his moves have been within the Darwin area and he has hopes of some leave soon. He writes "Have plenty of work to do...its one thing being at a place where everything is at hand and quite another thing when most of the things have to be improvised." (This chap has the makings of a Ham, anyhow...Ed.) We have a few boongs around the camp and they are invaluable for climbing trees....the camp is pretty good, "fairly" dry in the rain and we have had some good storms so far....plenty of water since the rains. We also get a bit of fresh fish which the boongs spear. They use a three prong job and when they see a fish about five pounds (hope this isn't another fish yard. Ed) they heave the spear and there's your fish... Price.....One cigarette.

And so until next month...cheerio....all notes to --
78 Maloney St., Eastlakes, MascotPhone MU1092.

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D I V I S I O N A L N O T E S .

The Editor regrets the exclusion of the New South Wales Divisional Notes. This is due to the fact that at the time of going to press they had not arrived.

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V I C T O R I A N D I V I S I O N

The March meeting of the Victorian Division was one of the largest for some time. The subject set down for discussion was Post War re-construction of Amateur Radio. Very little of this vital subject however was discussed, as the main topic of the evening was of present interest, that of the possibilities of establishing a Radio Communications Net to cover the fighting of Bush Fires.

As mentioned in last months magazine Divisional Council has for some time been negotiating with Authorities who were interested in such a scheme. Unfortunately much of the information received by Council has been confidential and at present we are unable to tell all the information at the disposal of council. The discussion at the meeting finally ended by the moving of a motion expressing members confidence in Council on the manner in which they were handling the matter. At present the matter rests with a request of the authorities for a demonstration of traffic handling. This demonstration will be staged at a District Meeting which will be held in Hamilton about the middle of April.

At the March meeting there was a large attendance of country members, Bruce Mann 3BM, Tim Wells 3TW, Mort Riley 3TN, Bruce Plowman 3QC, J. Anderson 3JA, R. Jonasson 3ND, Neil Templeton 3HK. If I've missed anyone please forgive me....No I've not forgotten Bill Williams 3WE and Keith Scott 3SS, because as they are in the armed services, I more or less count them as regulars.

However this attendance of country members has in some measure been responsible for the re-formation of the country zones. The Western Zone seems to be the most fortunate as there are more members actually living in that zone than in the others. The organisation of that zone is well under weigh under the capable guidance of Tim Wells 3TW and Bruce Plowman 3QC, and those interested should contact these two Hams.

Unfortunately the Eastern Zone has, as far as is known, only three members actually living in the area, but Ron Jardine 3FR is endeavouring to do some thing. The Northern Zone also only has a few members and in this case Bruce Mann 3BM is trying to create some interest. Zone members interested should contact either 3FR or 3BM.

It was fortunate that all these country members were able to be in the city at the same time and attend this particular meeting, as Council welcomes any opportunity of closer co-operation with the country Ham. It is hoped that in the future that this co-operation will be carried out to its fullest extent.

To this end at a subsequent Council meeting, at the request of the Western Zone Mr. T. D. Hogan VK3HX was appointed Council Representative for that Zone.

In preparation of the re-organisation of the magazine Council at its last meeting appointed Mr. J. G. Marsland VK3NY as Manager, Mr. T. D. Hogan VK3HX as Editor, and Mr. R. A. G. Anderson VK3WY as Technical Editor.

In an endeavour to establish a library of technical information and data, Council has decided that the Laboratory Committee in future peruse all Technical Magazines and such like publications so that the information contained therein may be filed and at the same time indexed, so that in the future members may have at their disposal any technical information they may desire. It must be understood, of course, that this will take some time to establish, and the Laboratory Staff would welcome any help offered.

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REVIVING OLD IDEAS.

A well-known engineer said that, should he have a hand in the development of post war radio-electronic products, he would set a group of men to digging in the dust of the past in search of new ideas.

What he means is that many ideas which have come along before the science of radio was really ready for them are worth reviving in the light of modern technique.

A case in point is the original RCA loop-operated receiver using type 199 tubes. The use of a loop antenna in those days when gain was hard to obtain, was not too successful. Later when gain became cheap and easy to obtain, the loop was resurrected, and to very good advantage.

It is also interesting to observe that a condenser phonograph pickup was developed around 1924 or so. It was designed for use in conjunction with an RF oscillator and some form of

detector and had no particular advantages over other pickups. But there are indications now that the capacity pickup, used in conjunction with a small FM unit, may find widespread use in the post war period.

Speakers are another case in point. Small speakers with rather good efficiency and frequency response can be developed if the cone has sufficient rigidity, and at the same time a rather large excursion. The answer to this problem may well rest in the use of a single turn voice coil. If that is the case it will be found that such a voice coil was first used in a dynamic speaker about 1924.

The future is always indebted to the past in some manner, and it is good engineering practice to constantly revalue old ideas in the light of new developments.

....."Radio."

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(Continued from Page 5)

maintained at RF earth potential. The second valve functions as the amplifier of the Heising modulation system. For reception these valves operate respectively as super-regenerative detector and AF amplifier. The set has a frequency range of from 52.8 to 65.8 Mc/s; there is a separation of 400 Kc/s between the 33 available frequencies. Battery life is sufficient for 20 hours continuous operation; the life is 3 or 4 times as long with intermittent operation.

The set is housed in an aluminium alloy case. Among the accessories is a break-in box, which connects to the battery plug of the set; this provides means for connecting separate batteries to the set if required, and also enables meters to be connected to the various circuits. The controls and components mounted on the front panel of the set, comprise tuning calibration switch, calibration adjuster, filament resistance and switch, filament voltmeter and microphone and headphone sockets.

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